

WHAT IS CLAIMED IS:

- 1 1. A plasma reactor system for processing a substrate, the plasma reactor
2 comprising:
 - 3 a processing chamber for containing a plasma, the plasma comprising at least
4 one plasma product for processing the substrate;
 - 5 a gas inlet coupled to the processing chamber for providing gas to the
6 processing chamber;
 - 7 a first power source;
 - 8 an induction coil, coupled to the first power source, to couple power from the
9 first power source into the processing chamber to sustain the plasma;
 - 10 a plasma shaping member positioned within the processing chamber, the
11 plasma shaping member having a recessed portion substantially above the center of
12 the substrate and an extended portion outside the recessed portion; and
 - 13 a support for the substrate positioned such that the substrate is exposed to the
14 at least one plasma product during processing.
- 1 2. The reactor system of claim 1, wherein the material comprising the plasma
2 shaping member is selected from the group consisting of quartz, silicon carbide,
3 ceramic, and metal.
- 1 3. The reactor system of claim 1, wherein the electrical potential of the plasma
2 shaping member is floating relative to ground during processing of the substrate.
- 1 4. The reactor system of claim 1, wherein the plasma shaping member is
2 configured such that the recessed portion and the extended portion face the
3 substrate.
- 1 5. The reactor system of claim 1, wherein the outside diameter of the plasma
2 shaping member ranges from 60 to 90 percent of the diameter of the substrate.
- 1 6. The reactor system of claim 1, wherein a Z dimension of the plasma shaping
2 member is greater than from about 10 to 15 percent of the outside dimension of the

3 plasma shaping member, and less than from about 25 to 30 percent of the outside
4 dimension of the plasma shaping member.

1 7. The reactor system of claim 1, wherein an X dimension and a Y dimension
2 of the plasma shaping member are each between 0.3 and 0.5 inches.

1 8. The reactor system of claim 1, wherein the sum of an X dimension and a Y
2 dimension of the plasma shaping member are each as great as at least 10 percent of
3 the height of the processing chamber.

1 9. The reactor system of claim 1, wherein the plasma uniformity is better than
2 about ± 15 percent.

1 10. The reactor system of claim 1 further comprising a top wall of the processing
2 chamber, and wherein the plasma shaping member is positioned adjacent to the top
3 wall of the processing chamber.

1 11. The reactor system of claim 1, further comprising a split Faraday shield.

1 12. The reactor system of claim 1, further comprising a charged particle filter.

1 13. The reactor system of claim 1, wherein the plasma shaping member is
2 configured such that high temperature electrons are produced adjacent to the
3 induction coil and are substantially blocked from diffusing toward the center of the
4 processing chamber.

1 14. The reactor system of claim 1, wherein the plasma shaping member provides
2 a surface on which positive ions from the plasma and negatively charged species
3 from the plasma may recombine.

1 15. The reactor system of claim 1, wherein the uniformity of the ion flux to the
2 substrate is better than ± 15 percent.

1 16. The reactor system of claim 1, wherein the maximum potential surface over
2 the substrate is substantially flat.

- 1 17. A method of processing a substrate in a reactor system, the method
- 2 comprising the steps of:
 - 3 providing a processing chamber;
 - 4 coupling power into the processing chamber to produce a plasma from which
 - 5 at least one product is used for processing the substrate;
 - 6 providing a plasma shaping member within the processing chamber;
 - 7 exposing the substrate to the at least one plasma product for processing.

1 18. The method of claim 17, further comprising the step of producing a plasma
2 with an ion current density uniformity less than plus or minus 10 percent over the
3 majority of the substrate for a processing chamber diameter less than 1.3 times the
4 size of the substrate.

1 19. The method of claim 17, further comprising the step of producing a
2 substantially flat maximum potential surface over the substrate.

1 20. The method of claim 17, further comprising the step of recombining positive
2 ions and negatively charged species on a surface of the plasma shaping member.

1 21. The method of claim 17, further comprising the step of preventing high
2 temperature electrons produced adjacent to the induction coil from diffusing toward
3 the center of the processing chamber.